What is claimed is:

1. An optical element capable of transmitting light, comprising:

an optical surface having an optical axis;

diffractive grooves provided on at least a part of the optical surface and each of the diffractive grooves including

a first surface capable of being approximated by a predetermined optical function;

a second surface extending in a direction to cross the first surface and being parallel to the optical axis with an angular error not greater than 1°; and

a third surface not approximated by the predetermined optical function and to connect the first surface and the second surface;

wherein a width of the third surface in the direction perpendicular to the optical axis is 0.5% to 15% of the sum of a width of the first surface in the direction perpendicular to the optical axis and the width of the third surface in the direction perpendicular to the optical axis.

2. The optical element of claim 1, wherein the predetermined optical function is represented by the following formula:

$$N = INT(Ah^2 + Bh^4 + C),$$

$$X(h,N) = h^2/(r_N(1 + \sqrt{(1 - (1 + K_N)h^2/r_N^2)})) + A4_N h^4 + A6_N h^6 + A8_N h^8 + A10_N h^{10} + \Delta N,$$

where N denotes the number of a ring-shaped zone of each of the diffractive grooves, h denotes a height from the optical axis, X denotes a distance from a tangent plane in the direction of the optical axis, r_N denotes a radius of a curvature of N-th ring-shaped zone, $K_N A4_N$ to $A10_N$ are coefficients of an aspherical surface of the N-th ring-shaped zone, and $\Delta = -\lambda_0/(n - 1)$ denotes an amount of a face shift corresponding to $1\lambda_0$ on the optical axis.

3. The optical element of claim 1, wherein the optical element is a coupling lens for use in an optical pickup apparatus used for an information recording and/or reproducing apparatus.

4. The optical element of claim 3, wherein the optical element is an objective lens to converge a parallel light flux parallel to the optical axis.

5. The optical element of claim 3, wherein the optical element is an objective lens to converge a divergent light flux divergent to the direction of the optical axis.

6. The optical element of claim 3, wherein the optical element is a collimator.

7. An optical element capable of transmitting light, comprising:

an optical surface having an optical axis;

diffractive grooves provided on at least a part of the optical surface and each of the diffractive grooves including

a first surface capable of being approximated by a predetermined optical function; and

a second surface extending in a direction to cross the first surface;

wherein a surface roughness Rz of the first surface is not larger than 1/10 of a using wavelength of a light source.

8. The optical element of claim 7, wherein the predetermined optical function is represented by the following formula:

$$N = \mathrm{INT}(Ah^2 + Bh^4 + C),$$

$$X(h,N) = h^2/(r_N(1 + \sqrt{(1 - (1 + K_N)h^2/r_N^2)})) + A4_N h^4 + A6_N h^6 + A8_N h^8 + A10_N h^{10} + \Delta N,$$

where N denotes the number of a ring-shaped zone of each of the diffractive grooves, h denotes a height from the optical axis, X denotes a distance from a tangent plane in the direction of the optical axis, r_N denotes a radius of a curvature of N-th ring-shaped zone, $K_N A4_N$ to $A10_N$ are coefficients of an aspherical surface of the N-th ring-shaped zone, and $\Delta = -\lambda_0/(n - 1)$ denotes an amount of a face shift corresponding to $1\lambda_0$ on the optical axis.

9. The optical element of claim 7, wherein a second surface is parallel to the optical axis with an angular error not greater than 1°.

10. The optical element of claim 7, wherein the optical element is a coupling lens for use in an optical pickup apparatus used for an information recording and/or reproducing apparatus.

11. The optical element of claim 7, wherein the optical element is an objective lens to converge a parallel light flux parallel to the direction of the optical axis.

12. The optical element of claim 7, wherein the optical element is an objective lens to converge a divergent light flux divergent to the direction of the optical axis.

13. The optical element of claim 7, wherein the optical element is a collimator lens.

14. A metallic die for molding an optical element capable of transmitting light, wherein the optical element comprises an optical surface having an optical axis; diffractive grooves provided on at least a part of the optical surface and each of the diffractive grooves including a first surface capable of being approximated by a predetermined optical function and a second surface extending in a direction to cross the first surface;

the metallic die comprising:

a surface corresponding to the first surface of the optical element,

wherein the surface is formed by a rotating cutting process with a cutting tool, and

wherein a feed rate of the cutting tool in a radius direction is 0.1 μm to 1 μm per one rotation of the metallic die.

15. The metallic die of claim 14, wherein a second surface is parallel to the optical axis with an angular error not greater than 1°.

16. An optical element produced by injection molding or by injection compression molding with the metallic die recited in claim 14.

17. The optical element of claim 16, wherein the predetermined optical function is represented by the following formula:

$$N = \mathrm{INT}(Ah^2 + Bh^4 + C),$$

$$X(h,N) = h^2/(r_N(1 + \sqrt{(1 - (1 + K_N)h^2/r_N^2)})) + A4_Nh^4 + A6_Nh^6 + A8_Nh^8 + A10_Nh^{10} + \Delta N,$$

where N denotes the number of a ring-shaped zone of each of the diffractive grooves, h denotes a height from the optical axis, X denotes a distance from a tangent plane in the direction of the optical axis, r_N denotes a radius of a curvature of N-th ring-shaped zone, $K_N A4_N$ to $A10_N$ are coefficients of an aspherical surface of the N-th ring-shaped zone, and $\Delta = -\lambda_0/(n - 1)$ denotes an amount of a face shift corresponding to $1\lambda_0$ on the optical axis.

18. The optical element of claim 16, wherein the optical element is a coupling lens for use in an optical pickup apparatus used for an information recording and/or reproducing apparatus.

19. The optical element of claim 16, wherein the optical element is an objective lens to converge a parallel light flux parallel to the direction of the optical axis.

20. The optical element of claim 16, wherein the optical element is an objective lens to converge a divergent light flux divergent to the direction of the optical axis.

21. The optical element of claim 16, wherein the optical element is a collimator lens.

22. A cutting tool for cutting a metallic die for molding an optical element capable of transmitting light, wherein the optical element comprises an optical surface having an optical axis; diffractive grooves provided on at least a part of the optical surface and each of the diffractive grooves including a first surface capable of being approximated by a predetermined optical function; a second surface extending in

a direction to cross the first surface; and a third surface to connect the first surface and the second surface, and wherein the at least a part of the metallic mold is formed by a rotating cutting process with the cutting tool,

the cutting tool comprising:

a rake face opposite to a rotation direction of the metallic die at the time of the rotating cutting process;

the rake face formed by

a first edge to cut a surface of the metallic die corresponding to the second surface of the optical element,

a second edge extending in a direction to cross the first edge, and

a third edge to connect the first edge and the second edge and to cut a surface of the metallic mold corresponding to the third surface of the optical element,

wherein a first extending line from the first edge and a second extending line from the second edge cross at a crossing point and a distance between the crossing point and the third edge is 0.1 μm to 3 μm.

23. A metallic mold manufactured by the cutting tool recited in claim 22.

24. The metallic mold of claim 23, wherein a second surface is parallel to the optical axis with an angular error not greater than 1°.

25. An optical element produced by injection molding or by injection compression molding with the metallic die recited in claim 23.

26. The optical element of claim 25, wherein the predetermined optical function is represented by the following formula:

$$N = \mathrm{INT}(Ah^2 + Bh^4 + C),$$

$$X(h,N) = h^2/(r_N(1 + \sqrt{(1 - (1 + K_N)h^2/r_N^2)})) + A4_N h^4 + A6_N h^6 + A8_N h^8 + A10_N h^{10} + \Delta N,$$

where N denotes the number of a ring-shaped zone of each of the diffractive grooves, h denotes a height from the optical axis, X denotes a distance from a tangent plane in the direction of the optical axis, r_N denotes a radius of a curvature of N-th ring-shaped zone, $K_N A4_N$ to $A10_N$ are coefficients of an aspherical surface of the N-th ring-shaped zone, and $\Delta = -\lambda_0/(n - 1)$ denotes an amount of a face shift corresponding to $1\lambda_0$ on the optical axis.

27. The optical element of claim 25, wherein the optical element is a coupling lens for use in an optical pickup apparatus used for an information recording and/or reproducing apparatus.

28. The optical element of claim 25, wherein the optical element is an objective lens to converge a parallel light flux parallel to the direction of the optical axis.

29. The optical element of claim 24, wherein the optical element is an objective lens to converge a divergent light flux divergent to the direction of the optical axis.

30. The optical element of claim 24, wherein the optical element is a collimator lens.

31. A cutting tool for cutting a metallic die for molding an optical element capable of transmitting light, wherein the optical element comprises an optical surface having an optical axis; diffractive grooves provided on at least a part of the optical surface and each of the diffractive grooves including a first surface capable of being approximated by a predetermined optical function; a second surface extending in a direction to cross the first surface; and a third surface

to connect the first surface and the second surface, and wherein the at least a part of the metallic mold is formed by a rotating cutting process with the cutting tool,

the cutting tool comprising:

a rake face opposite to a rotation direction of the metallic die at the time of the rotating cutting process;

the rake face formed by

a first edge to cut a surface of the metallic die corresponding to the second surface of the optical element,

a second edge extending in a direction to cross the first edge, and

a third edge to connect the first edge and the second edge and to cut a surface of the metallic mold corresponding to the third surface of the optical element,

wherein an angle α formed between the first edge and the second edge satisfies the following conditional formula:

$$\theta max \leqq (90-(\alpha/2 + S))$$

where θmax is a maximum normal angle of the metallic die corresponding to the optical surface and S is a setting angle of the cutting tool to the optical axis of the optical surface.

32. A metallic mold manufactured by the cutting tool recited in claim 31.

33. The metallic mold of claim 32, wherein a second surface is parallel to the optical axis with an angular error not greater than 1°.

34. The metallic mold of claim 32, wherein the diffractive grooves are formed such that the maximum normal angle θmax is 40° to 70°.

35. An optical element produced by injection molding or by injection compression molding with the metallic die recited in claim 32.

36. The optical element of claim 35, wherein the predetermined optical function is represented by the following formula:

$$N = INT(Ah^2 + Bh^4 + C),$$

$$X(h,N) = h^2/(r_N(1 + \sqrt{(1 - (1 + K_N)h^2/r_N{}^2)})) + A4_Nh^4 + A6_Nh^6 + A8_Nh^8 + A10_Nh^{10} + \Delta N,$$

where N denotes the number of a ring-shaped zone of each of the diffractive grooves, h denotes a height from the optical

axis, X denotes a distance from a tangent plane in the direction of the optical axis, r_N denotes a radius of a curvature of N-th ring-shaped zone, $K_N A4_N$ to $A10_N$ are coefficients of an aspherical surface of the N-th ring-shaped zone, and $\Delta = -\lambda_0/(n - 1)$ denotes an amount of a face shift corresponding to $1\lambda_0$ on the optical axis.

37. The optical element of claim 35, wherein the optical element is a coupling lens for use in an optical pickup apparatus used for an information recording and/or reproducing apparatus.

38. The optical element of claim 35, wherein the optical element is an objective lens to converge a parallel light flux parallel to the direction of the optical axis.

39. The optical element of claim 35, wherein the optical element is an objective lens to converge a divergent light flux divergent to the direction of the optical axis.

40. The optical element of claim 35, wherein the optical element is a collimator lens.

41. A cutting tool for cutting a metallic die for molding an optical element capable of transmitting light, wherein the optical element comprises an optical surface having an optical axis; diffractive grooves provided on at least a part of the optical surface and each of the diffractive grooves including a first surface capable of being approximated by a predetermined optical function; a second surface extending in a direction to cross the first surface; and a third surface to connect the first surface and the second surface, and wherein the at least a part of the metallic mold is formed by a rotating cutting process with the cutting tool,

the cutting tool comprising:

a rake face opposite to a rotation direction of the metallic die at the time of the rotating cutting process, the rake face formed by

a first edge to cut a surface of the metallic die corresponding to the second surface of the optical element,

a second edge extending in a direction to cross the first edge, and

a third edge to connect the first edge and the second edge and to cut a surface of the metallic mold corresponding to the third surface of the optical element,

a first side surface forming the first edge with the rake face; and

a second side surface forming the second edge with the rake face;

wherein the first surface has a first inclination angle to the rake face, the second surface has a second inclination angle to the rake face, the first inclination angle is different from the second inclination angle, and a difference between the first inclination angle and the second inclination angle is 1° to 20°.

42. A metallic mold manufactured by the cutting tool recited in claim 41.

43. The metallic mold of claim 42, wherein a second surface is parallel to the optical axis with an angular error not greater than 1°.

44. An optical element produced by injection molding or by injection compression molding with the metallic die recited in claim 43.

45. The optical element of claim 44, wherein the predetermined optical function is represented by the following formula:

$$N = INT(Ah^2 + Bh^4 + C),$$

$$X(h,N) = h^2/(r_N(1 + \sqrt{(1 - (1 + K_N)h^2/r_N^2)})) + A4_Nh^4 + A6_Nh^6 + A8_Nh^8 + A10_Nh^{10} + \Delta N,$$

where N denotes the number of a ring-shaped zone of each of the diffractive grooves, h denotes a height from the optical axis, X denotes a distance from a tangent plane in the direction of the optical axis, r_N denotes a radius of a curvature of N-th ring-shaped zone, K_NA4_N to $A10_N$ are coefficients of an aspherical surface of the N-th ring-shaped zone, and $\Delta = -\lambda_0/(n - 1)$ denotes an amount of a face shift corresponding to $1\lambda_0$ on the optical axis.

46. The optical element of claim 44, wherein the optical element is a coupling lens for use in an optical pickup apparatus used for an information recording and/or reproducing apparatus.

47. The optical element of claim 44, wherein the optical element is an objective lens to converge a parallel light flux parallel to the direction of the optical axis.

48. The optical element of claim 44, wherein the optical element is an objective lens to converge a divergent light flux divergent to the direction of the optical axis.

49. The optical element of claim 44, wherein the optical element is a collimator lens.

50. A cutting tool for cutting a metallic die for molding an optical element capable of transmitting light, wherein the optical element comprises an optical surface having an optical axis; diffractive grooves provided on at least a part of the optical surface and each of the diffractive grooves including a first surface capable of being approximated by a predetermined optical function; a second surface extending in a direction to cross the first surface; and a third surface to connect the first surface and the second surface, and wherein the at least a part of the metallic mold is formed by a rotating cutting process with the cutting tool,

the cutting tool comprising:

a rake face opposite to a rotation direction of the metallic die at the time of the rotating cutting process;

the rake face formed by

a first edge to cut a surface of the metallic die corresponding to the second surface of the optical element,

a second edge extending in a direction to cross the first edge, and

a third edge to connect the first edge and the second edge and to cut a surface of the metallic mold corresponding to the third surface of the optical element,

a first side surface forming the first edge with the rake face; and

a second side surface forming the second edge with the rake face;

wherein at least one of the first surface and the second surface has a first inclination angle to the rake face, crossing lines of the first surface and the second surface form a first clearance angle, at least one of the first surface and the second surface has a second inclination angle to the rake face, at least the side surface having the second inclination angle and another side surface form crossing lines and the crossing lines form a second clearance angle.

51. A metallic mold manufactured by the cutting tool recited in claim 50.

52. The metallic mold of claim 51, wherein a second surface is parallel to the optical axis with an angular error not greater than 1°.

53. An optical element produced by injection molding or by injection compression molding with the metallic die recited in claim 52.

54. The optical element of claim 53, wherein the predetermined optical function is represented by the following formula:

$$N = INT(Ah^2 + Bh^4 + C),$$

$$X(h,N) = h^2/(r_N(1 + \sqrt{(1 - (1 + K_N)h^2/r_N^2)})) + A4_N h^4 + A6_N h^6 + A8_N h^8 + A10_N h^{10} + \Delta N,$$

where N denotes the number of a ring-shaped zone of each of the diffractive grooves, h denotes a height from the optical axis, X denotes a distance from a tangent plane in the direction of the optical axis, r_N denotes a radius of a curvature of N-th ring-shaped zone, $K_N A4_N$ to $A10_N$ are coefficients of an aspherical surface of the N-th ring-shaped zone, and $\Delta = -\lambda_0/(n - 1)$ denotes an amount of a face shift corresponding to $1\lambda_0$ on the optical axis.

55. The optical element of claim 53, wherein the optical element is a coupling lens for use in an optical pickup apparatus used for an information recording and/or reproducing apparatus.

56. The optical element of claim 53, wherein the optical element is an objective lens to converge a parallel light flux parallel to the direction of the optical axis.

57. The optical element of claim 53, wherein the optical element is an objective lens to converge a divergent light flux divergent to the direction of the optical axis.

58. The optical element of claim 53, wherein the optical element is a collimator.